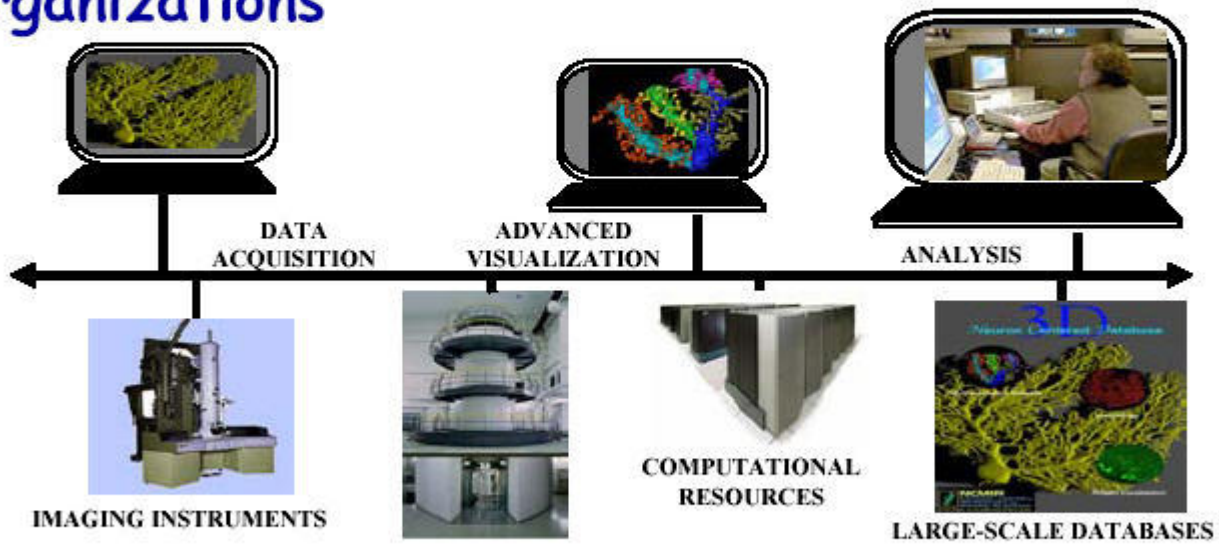
Sisteme Distruite–Tehnologii
3. Grid

Grid Computing is About …

Resource sharing & coordinated problem solving in dynamic, multi-institutional virtual organizations



"Telescience Grid", Courtesy of Mark Ellisman

Definitie

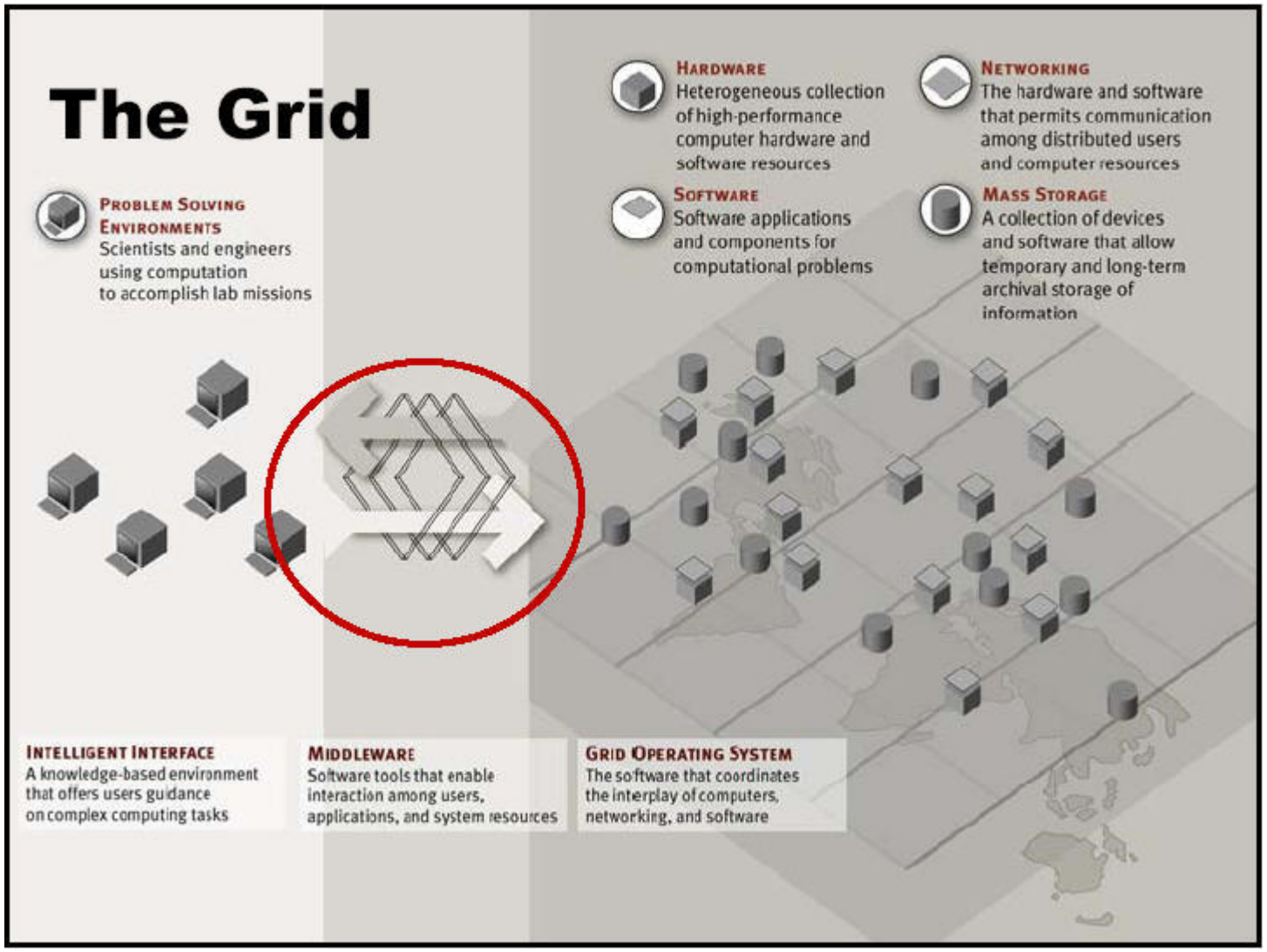
Tip de sistem **distribuit** care permite partajarea, selectia si agregarea unor resurse distribuite geografic:

- Calculatoare – PCuri, statii de lucru, clustere, supercalculatoare, laptopuri, dispozituve mobile, PDA, etc;
- Software – exemplu, inchiriere de aplicatii cu scop special si scumpe, la cerere
- Date catalogate si baze de date – exemplu, acces transparent la baza de date a genomului animal
- Instrumente si dispozitive speciale – exemplu, radio telescop – SETI@Home cautarea vietii in galaxie.
- Oameni/colaboratori.

depinzand de disponibilitatea lor, facilitati, cost si cerinte de calitate a serviciilor impuse de utilizatori

Petru rezolvarea de probleme/aplicatii pe scara larga

Astfel permitand crearea de "organizatii virtuale" (VOuri)


The Grid
Problem Solving Environments
Scientists and engineers using computation to accomplish lab missions
Hardware
Heterogeneous collection of high-performance computer hardware and software resources
Networking
The hardware and software that permits communication among distributed users and computer resources
Software
Software applications and components for computational problems
Mass Storage
A collection of devices and software that allow temporary and long-term archival storage of information
Intelligent Interface
A knowledge-based environment that offers users guidance on complex computing tasks
Middleware
Software tools that enable interaction among users, applications, and system resources
Grid Operating System
The software that coordinates the interplay of computers, networking, and software

Idea principala a Gridului

- A trata ciclurile de calcul si softwareul ca si produse-marfa
- Permite utilizarea coordonata a resurselor distribuite geografic - *in absenta controlului central si existenta relatiilor de incredere*
- Puterea de calcul este produsa ca utilitate precum curentul electric si apei potabile produse pentru consum
- Utilizatorii au acces la “ouetre” *la cerere*
- “Cand Reteaua este la fel de rapida ca legaturile interne ale calculatorului, masina se dezagregheaza in Retea intr-o multime de dispozitive cu scop sepcial” – Gilder Technology Report June 2000

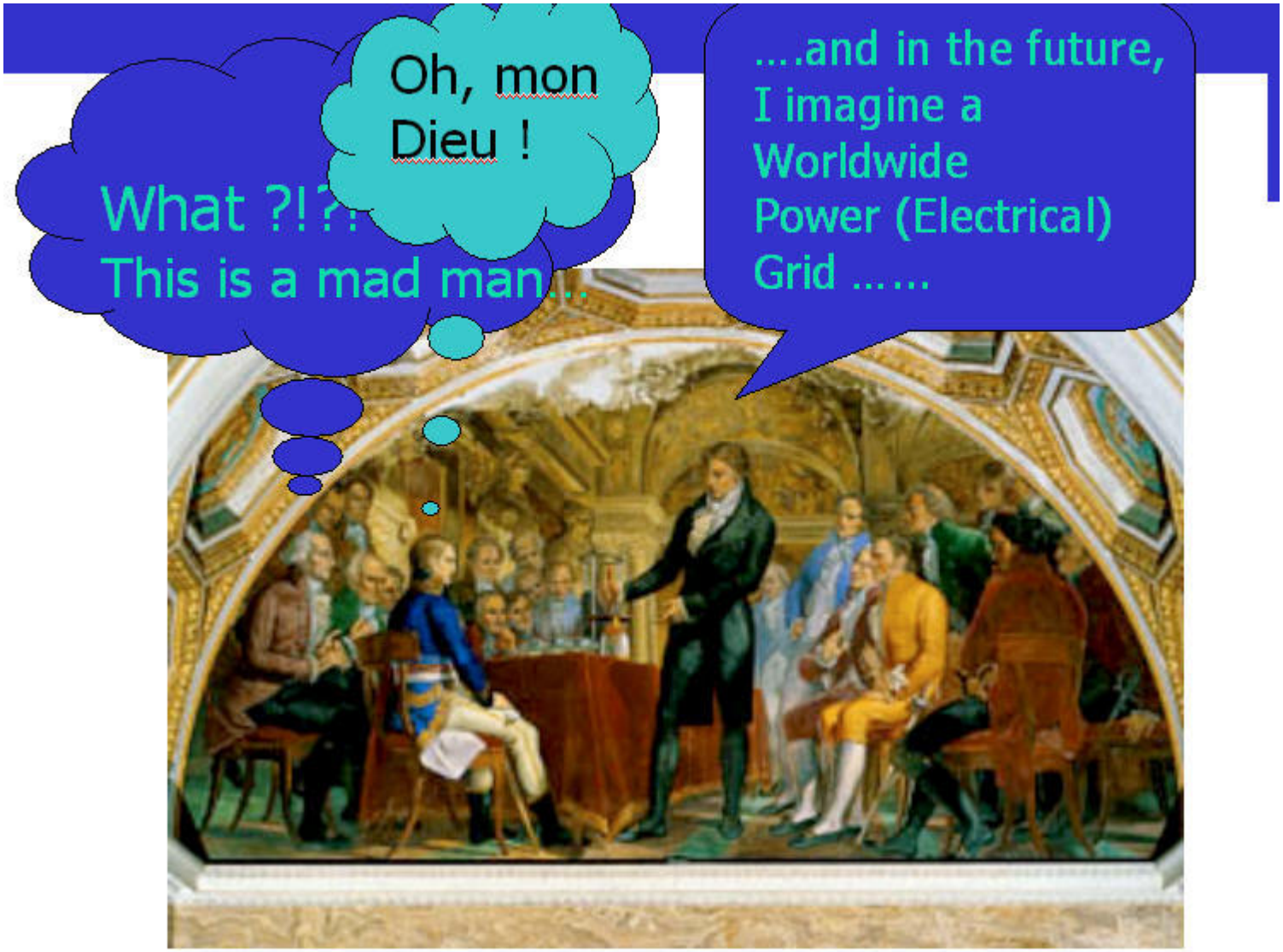
Gridurile de calcul si Gridul de distributie a curentului electric

- **Analogie cu distributia curentului electric**
  – Producatorii de putere: masini, software, retele, sisteme de stocare
  – Consumaturi de putere:aplicatii utilizator
- **Aplicatiile extrag putere din Grid in modalitatea in care dispozitivele extrag electricitate din utilitatea de putere electrica.**
  – Fara efort, Performanta inalta, Peste tot, Dependenta
- **De ce Gridul de calcul este ca si Gridul de putere electrica**
  – Puterea electrica este peste tot
  – Nu se cunoaste sursa puterii (transformator, generator) sau compania de putere care deserveste
- **De ce Gridul de calcul este diferit de catre Gridul de putere electrica**
  – Spectru mai lar pentru performanta
  – Spectru mai larg de servicii
  – Aces guvernat de tematice mai complicate precum securitatea si performanta

Alessandro Volta in Paris in 1801 inside French National Institute shows the battery while in the presence of Napoleon I

Fresco by N. Cianfanelli (1841)

(Zoological Section "La Specula" of National History Museum of Florence University)

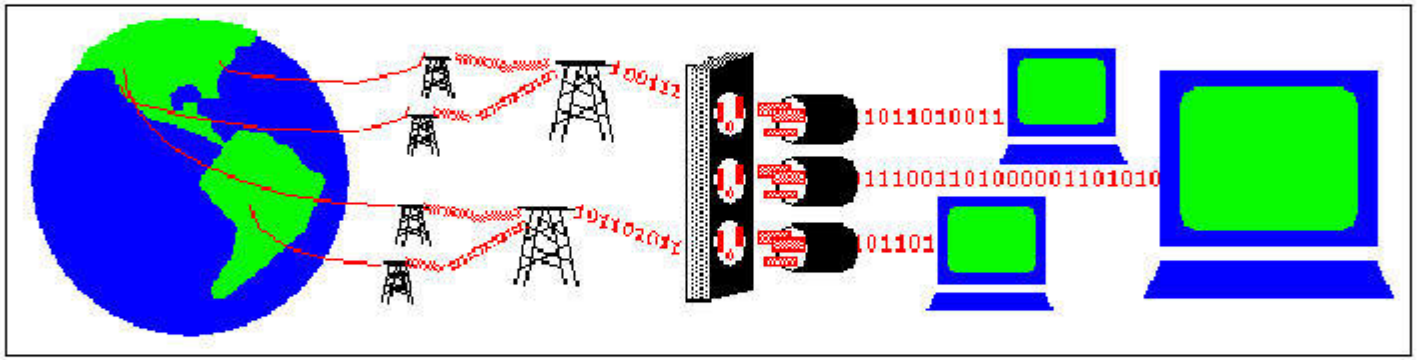

What ?!?!
This is a mad man…
Oh, mon Dieu !
….and in the future, I imagine a Worldwide Power (Electrical) Grid ……

2002 - 1801 = 201 Years

IPG: Analogy to Electric Power Grid

Principal benefits:

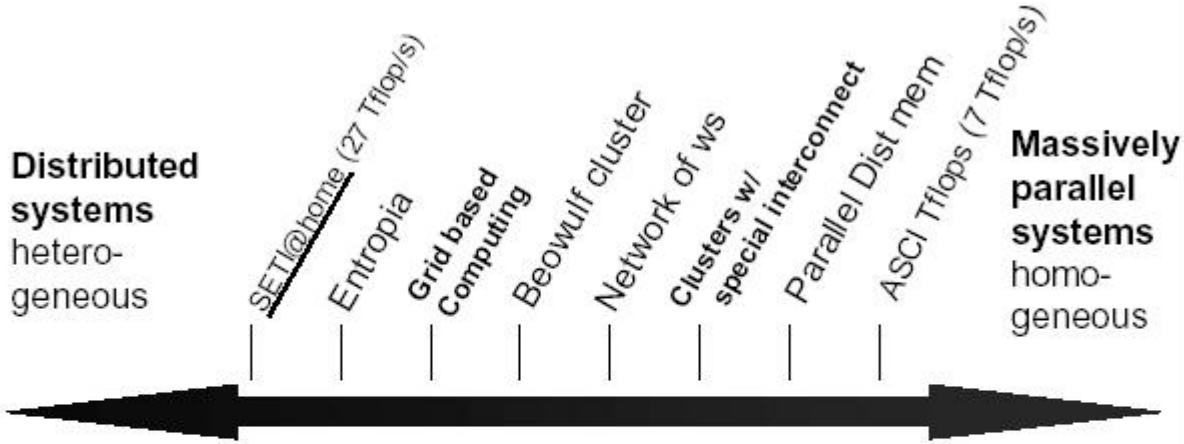
- load sharing/balancing
- fault tolerance, minimum loss-of-service
- economies of scale



Principal risks/challenges:

- possible fault domino effect
- reliance on facilities under other's control
- negotiation of agreements
- standards development and compliance policing

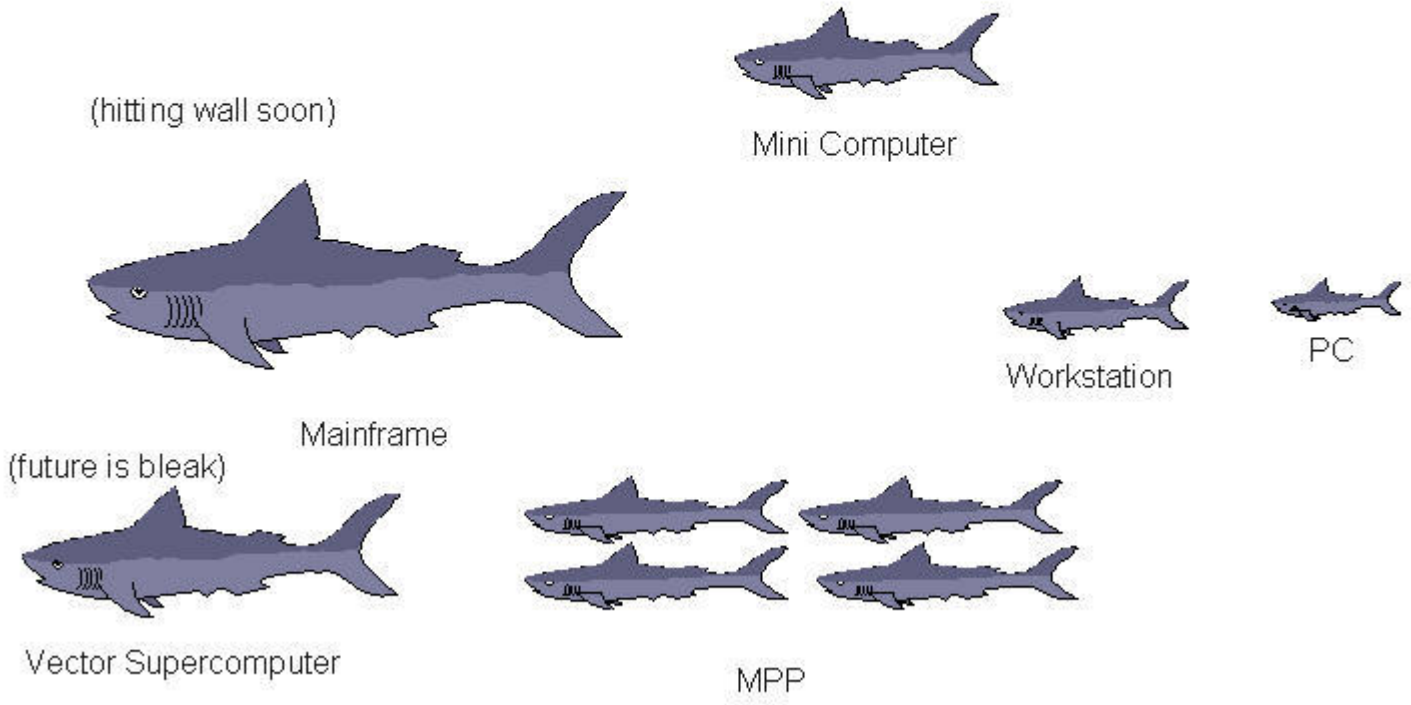
Distributed and Parallel Systems



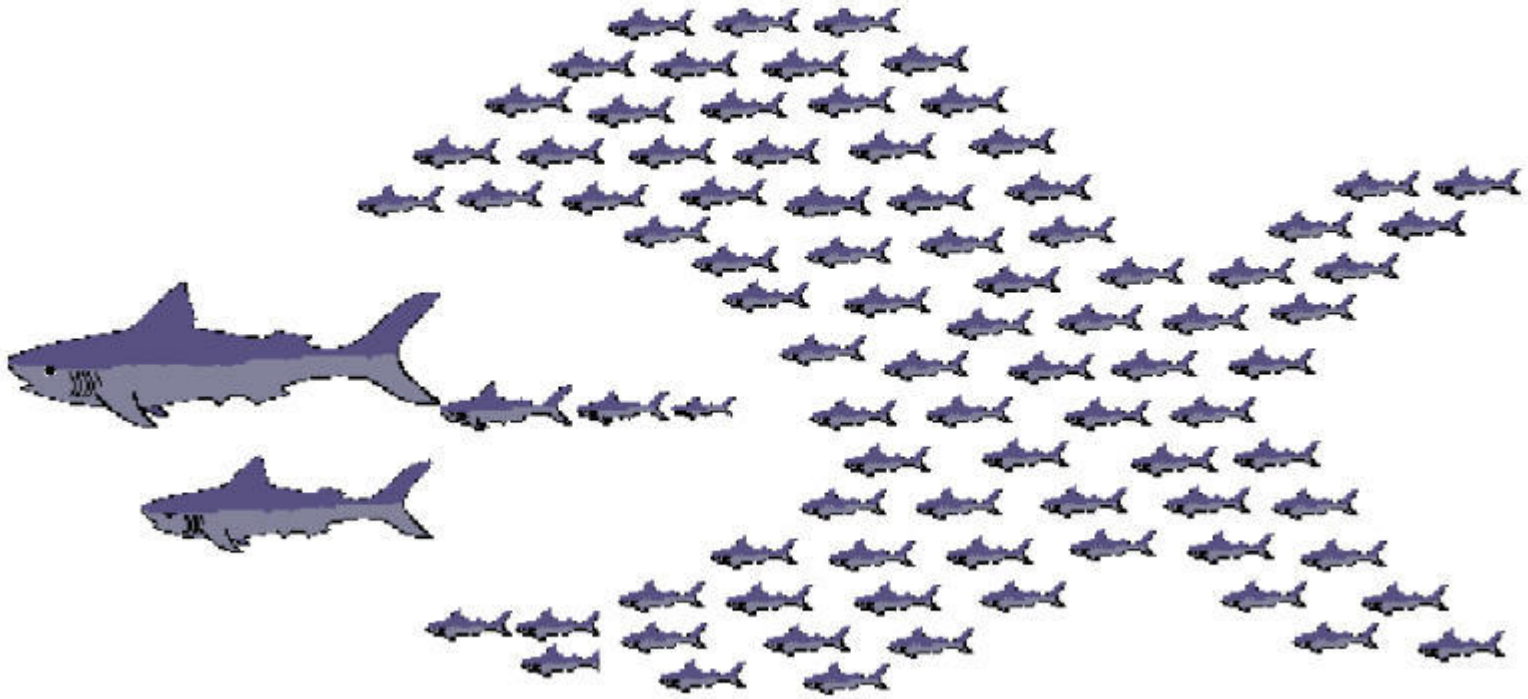
- Gather (unused) resources
- Steal cycles
- System SW manages resources
- System SW adds value
- 10% - 20% overhead is OK
- Resources drive applications
- Time to completion is not critical
- Time-shared

- Bounded set of resources
- Apps grow to consume all cycles
- Application manages resources
- System SW gets in the way
- 5% overhead is maximum
- Apps drive purchase of equipment
- Real-time constraints
- Space-shared

Early 1990 Computer Food Chain



Replacing Big Irons



P2P, Cluster, Calcul pe Internet vs. Calcul pe Grid

- ***Retelele Peer-to-peer*** (ex. Kazaa) intra in categoria calculului pe Grid
  - Resursa partajata este capacitatea de stocare a fiecarui nod
  - Un grup de lucru P2P face parte din Global Grid Forum (GGF)
- Un ***cluster*** este o resursa care poate fi partajata
  - Un Grid este un cluster de clustere
- ***Internet computing***:
  - Un VO este constituit pentru un proiect particular si dezactivat odata ce proiectul este complet
  - Resursa partajata este calculatorul conectat la Internet

Evolutia Gridului: prima generatie

Grid Evolution - Metacomputing

- Different Supercomputing Resourses
  - geographically distributed
  - used as a single **powerful** parallel machine (clear, High-Performance orientation)

Metacomputing

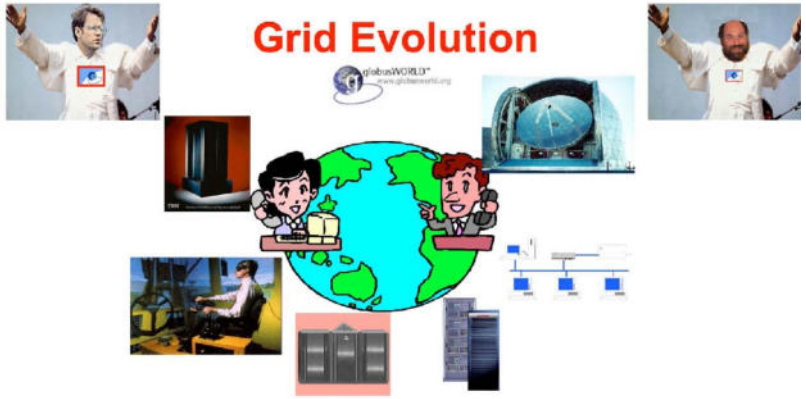
- The word metacomputing was coined to describe this new computational approach

California Institute for Telecommunications and Information Technology

- Reference:
- Larry Smarr & Charles E. Catlett
- Metacomputing
  - Communications of the ACM, 35(6):45-52, June 1992

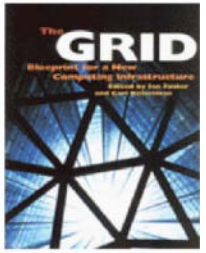
GGF

Evolutia Gridului: a doua generatie



Grid computing has emerged as an important new field, distinguished from conventional distributed computing by its focus on large-scale resource sharing, innovative applications, and, in some cases, high-performance orientation.

Grid Applications



- Distributed Supercomputing
  - Stellar Dynamics, Ab initio chemistry, ...
- High Throughput
  - Chip design, Parametric studies, ...
- On Demand
  - Medical instrumentation, network-enabled solvers, ...
- Data Intensive
  - Sky survey, Physics data, Data Mining, ...
- Collaborative
  - Collaborative design, data exploration, education, ...

Evolutia Gridului: a treia generatie

Grid Evolution

The marriage of the **Web technology** with the **2nd Generation Grid technology** led to new and generic Grid Services

The Physiology of the Grid

An Open Grid Services Architecture for Distributed Systems Integration

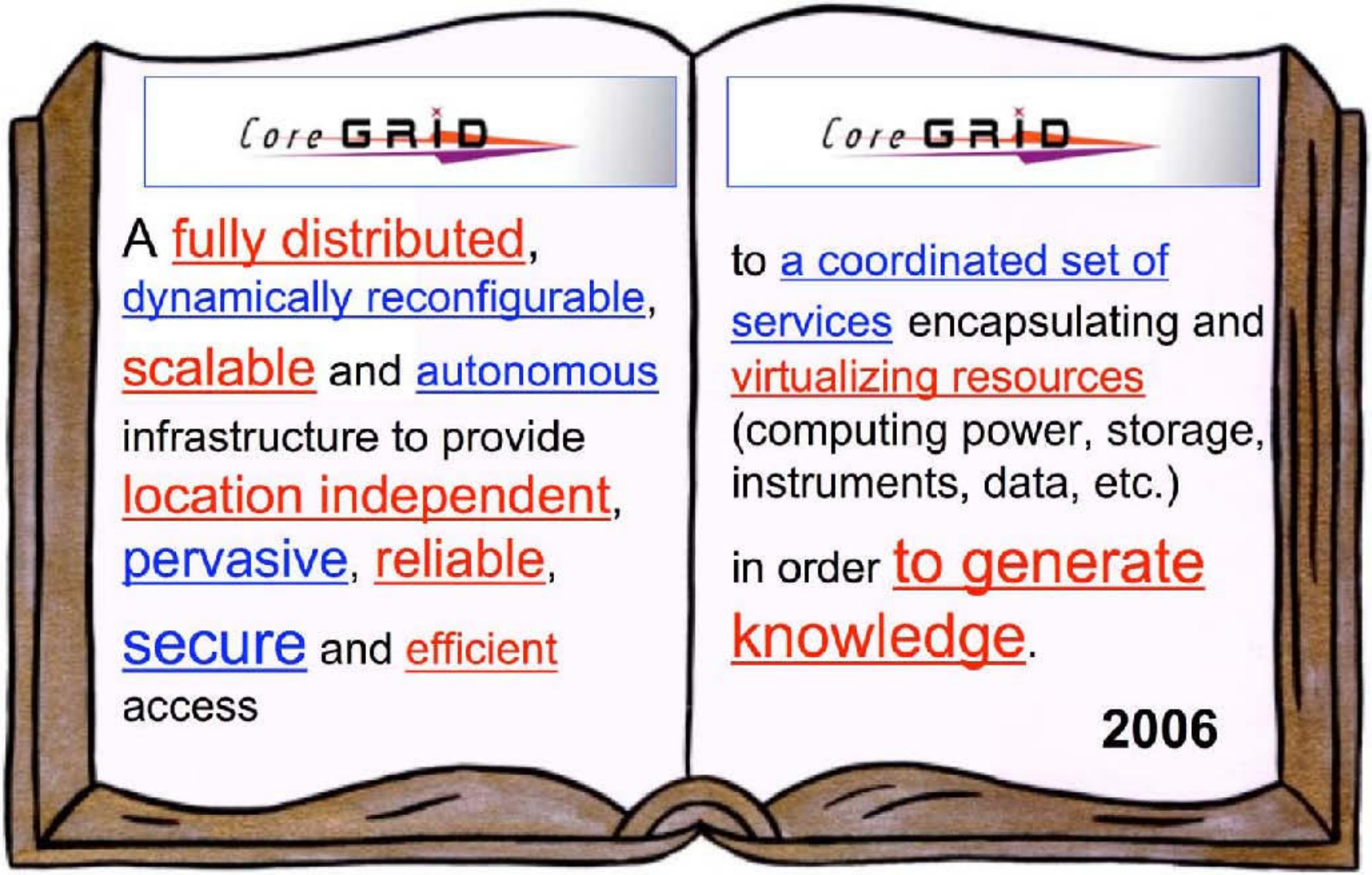
I. Foster, C. Kesselman, J. Nick, S. Tuecke, January, 2002

http://www.globus.org/research/papers/ogsa.pdf

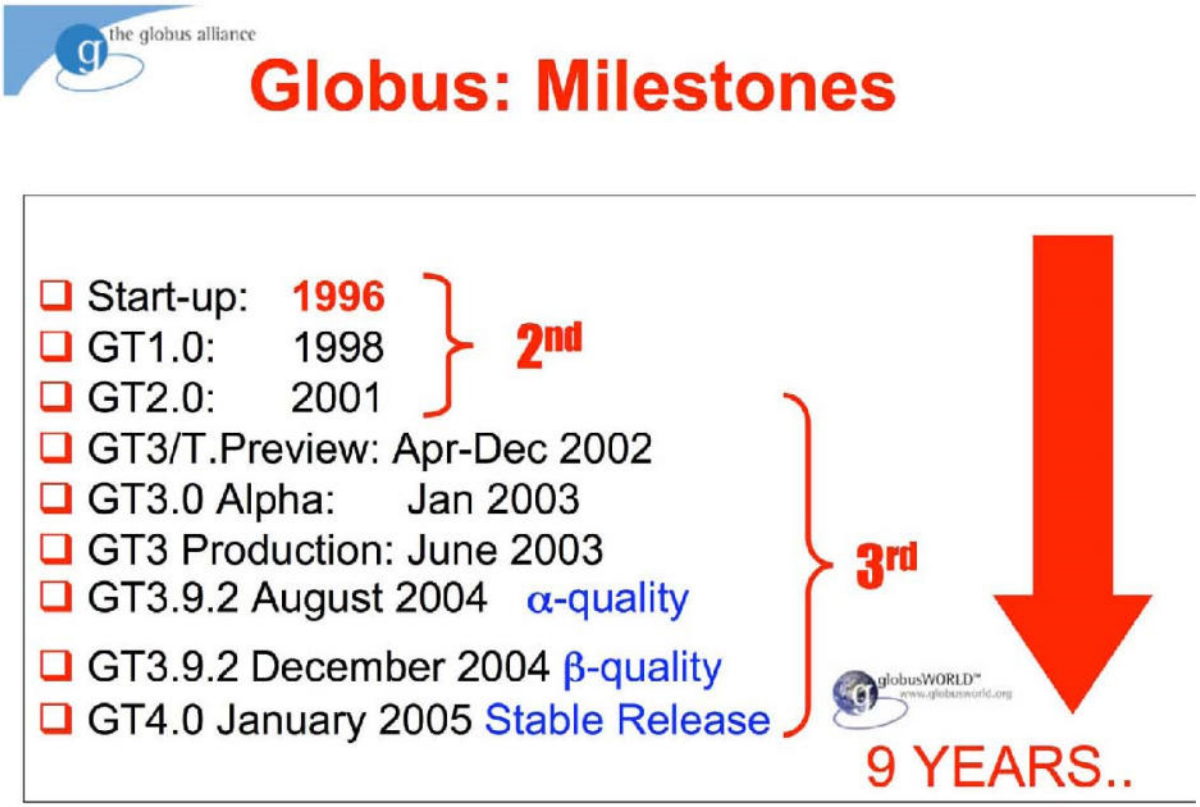
Servicii OGSA

- Open Grid Service Architecture,
  - Definit de grupul GGF
  - In platforma Grid sunt becesare anumite interfere, comportari, modele de resurse si legaturi
  - Defineste multimea de baza de servicii esentiale pentru Grid, functionalitatea lor si relatiile intre ele
  - Serviciile de baza: interactiunea, administrarea, comunicarea si securitatea
  - Servicii suplimentare: date, executii de programe, asdministrarea resurselor
- Serviciul Grid este un serviciu Web cu extensii, printre care:
  - Nume (handle - GSH, reference - GSR)
  - Managementul ciclului de viata a serviciului (servicii fabrica, persistente si tranziente)
  - Stare (Service Data)
  - Notificare si interogare

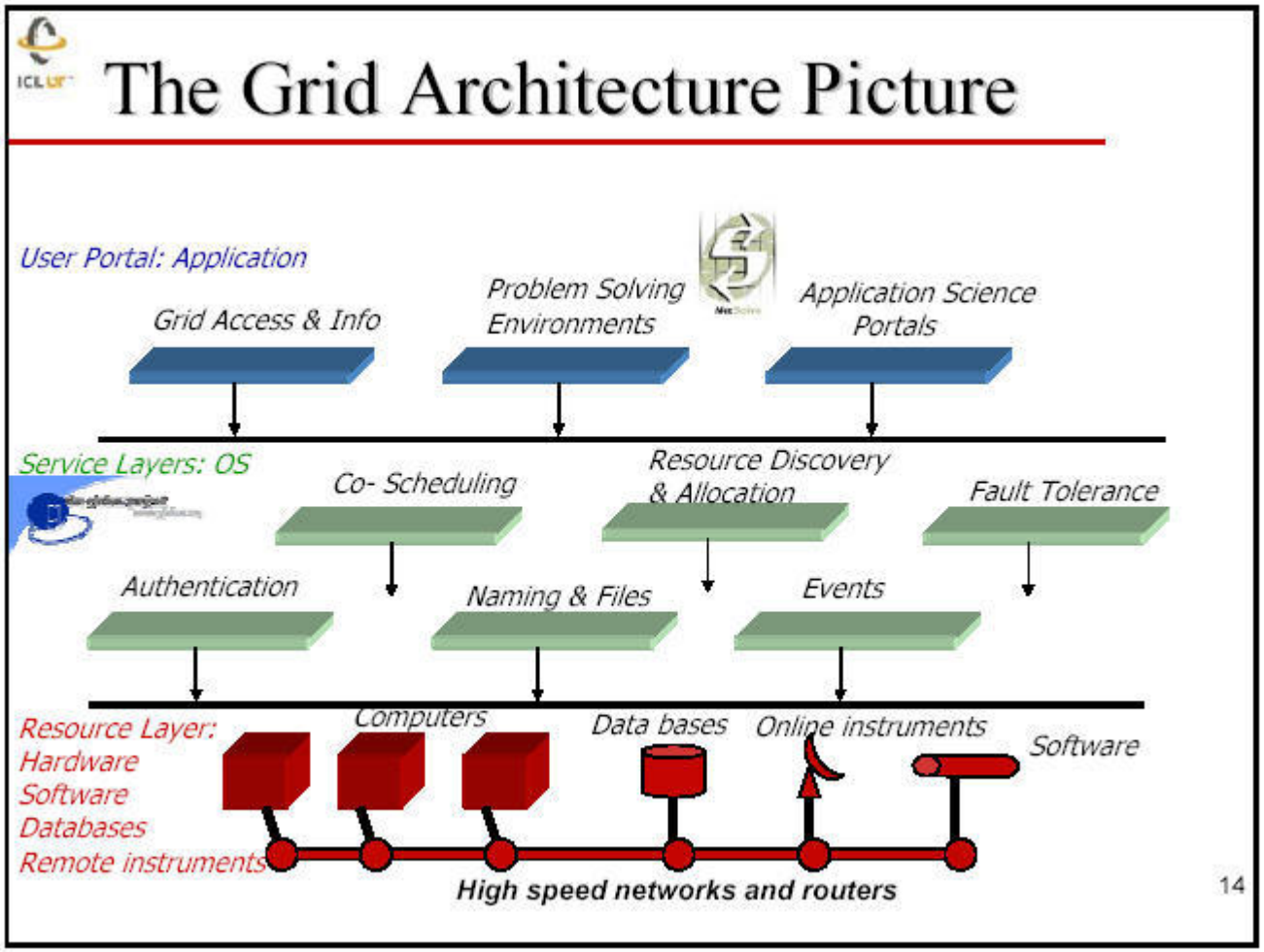
CoreGrid Definition of GRID



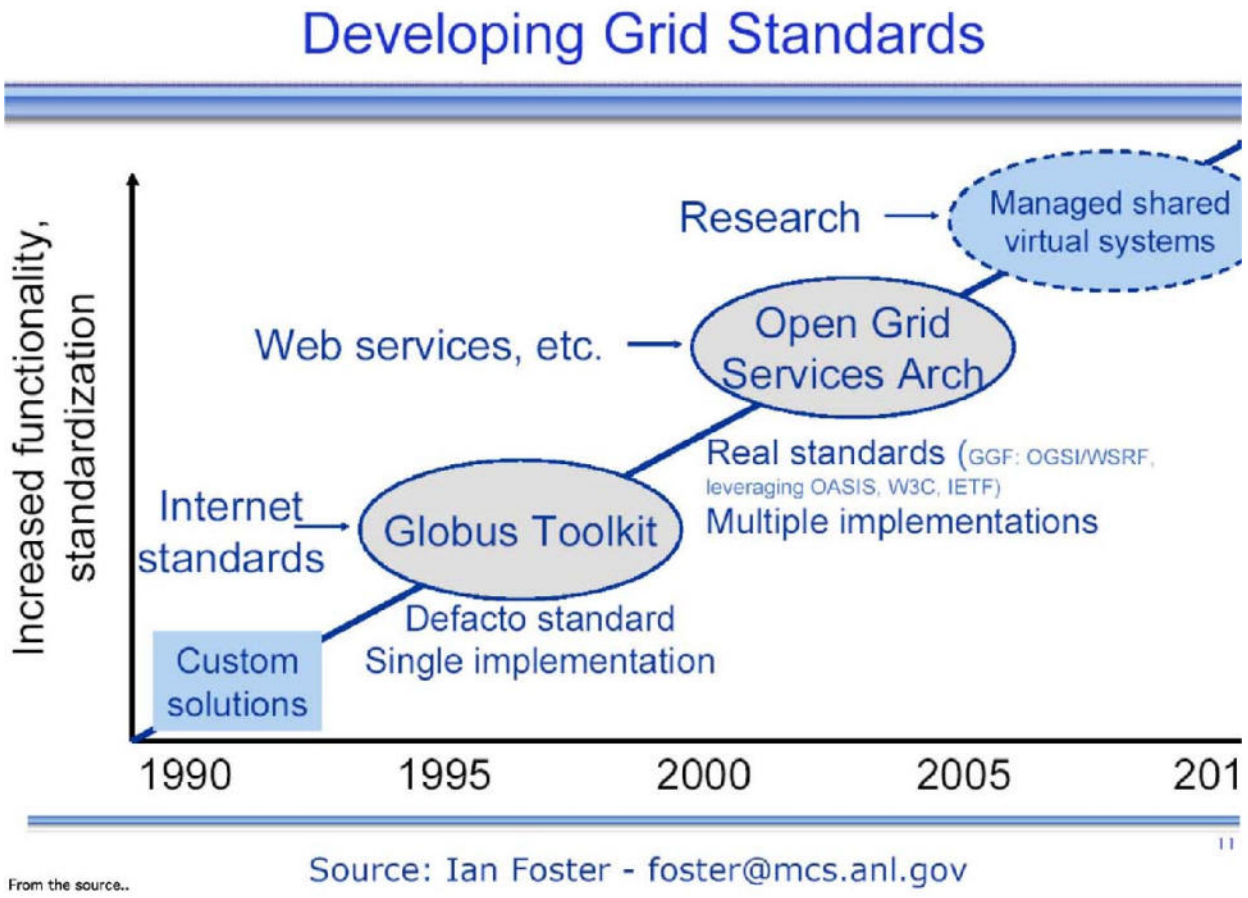
Middleware de facto: Globus Toolkit



The Grid Architecture Picture



Viitorul?


Developing Grid Standards
Increased functionality, standardization
Research
Managed shared virtual systems
Web services, etc.
Open Grid Services Arch
Real standards (GGF: OGSI/WSRF, leveraging OASIS, W3C, IETF)
Multiple implementations
Internet standards
Globus Toolkit
Defacto standard
Single implementation
Custom solutions
1990
1995
2000
2005
201
Source: Ian Foster - foster@mcs.anl.gov
From the source..

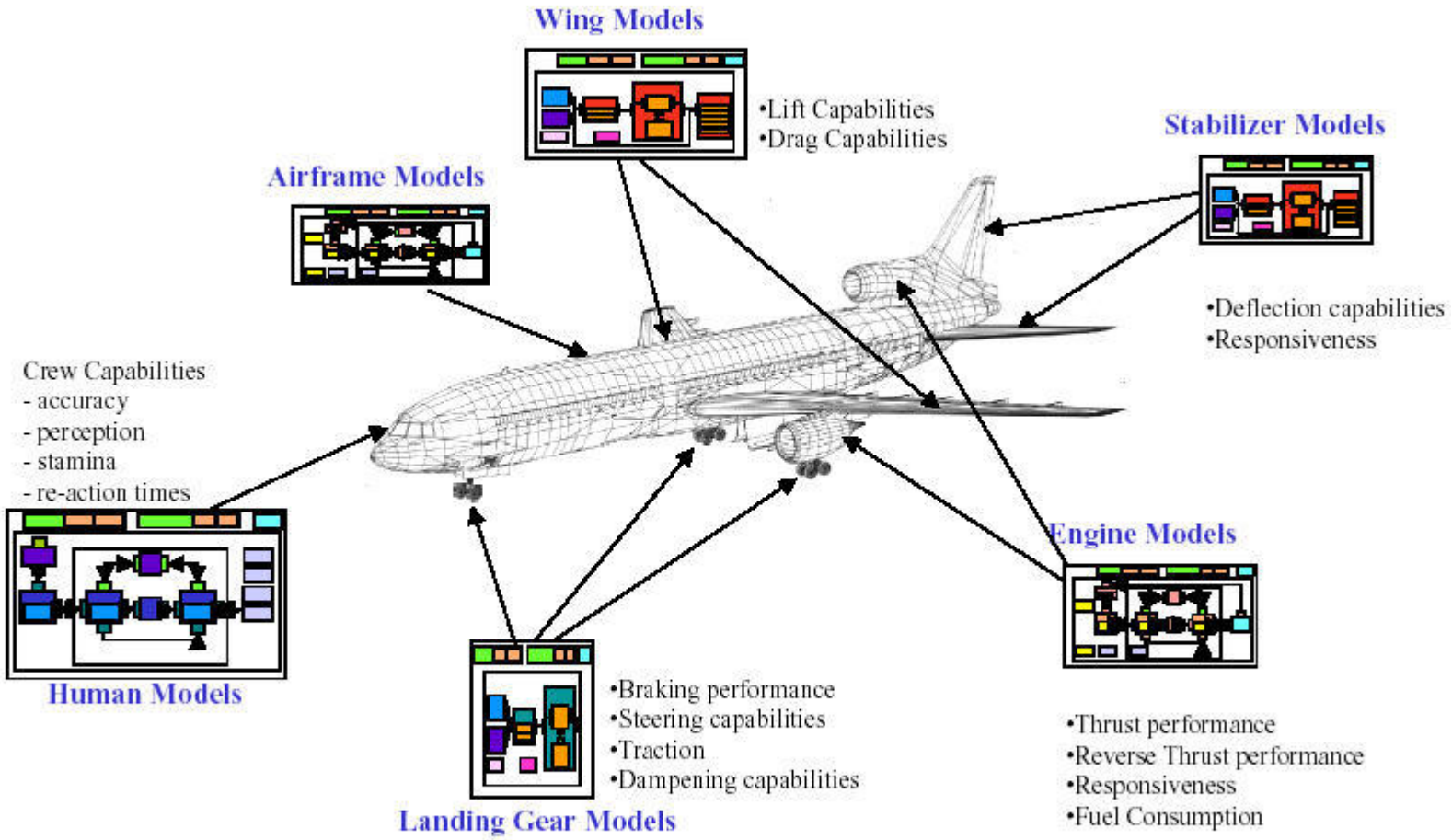
Ce vor utilizatorii ?

- Consumatorii de Grid
  - Sa execute joburi pentru rezolvarea de probleme cu marimi si complexitate variabile
  - Sa beneficieze de selectarea si agregarea resurselor intr-o varianta inteleapta
  - Sa poata negocia timpul si costul
- Distribuitorii de Grid
  - Sa contribuie cu resurse (“ne-ocupate”) pentru executia de jocuri ale consumatorilor
  - Sa beneficieze prin maximizarea utilizarii resurselor
  - Sa poata negocia intre cerintele locale si oportunitatile pietei

Aplicatii ale Gridului

- ***HPC distribuit (supercalcul*):**
  - Stiinta computationala
- ***Calcul la capacitate/patrundere inalta***
  - Studii parametrice, design chipuri, simulari pe scara larga
- ***Partajare de continut (liber sau platit*)**
  - Partajarea de continut digital intre semeni (ex., Napster)
- ***Acces la software la distanta/inchiriere servicii***
  - Application service provider (ASPs) & servicii Web
- ***Calcul intensiv in date***
  - Design medicamente, fizica particulelor, predictii de stoc...
- ***Calcul la cerere, in timp real***
  - Instrumentare medicala & Misiuni critice
- ***Calcul colaborativ:***
  - Design colaborativ, explorarea datelor, educatie
- ***Calcul orientat spre servicii (SOC):***
  - Inspre calcul utilitar bazat pe economie: aplicatii si business nou

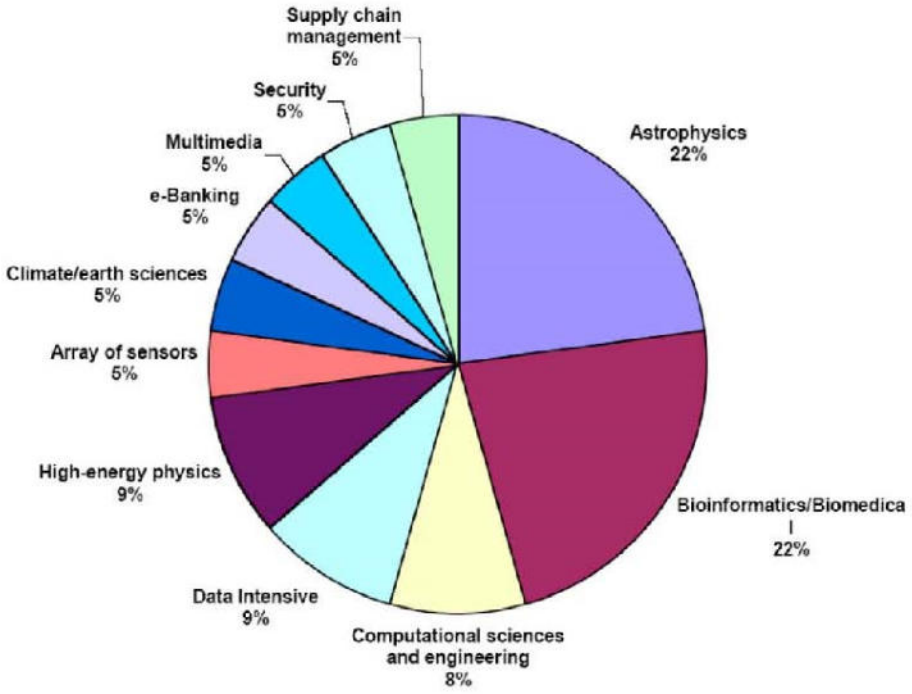
Multi-disciplinary Simulations



Whole system simulations are produced by coupling all of the sub-system simulations

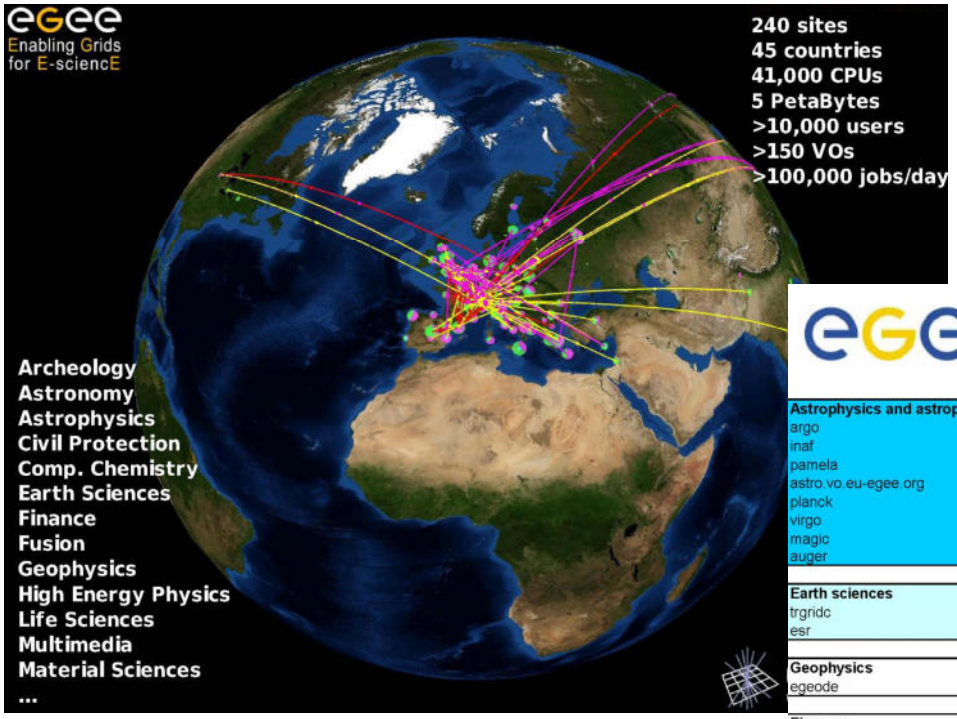
Statistici GridCoord

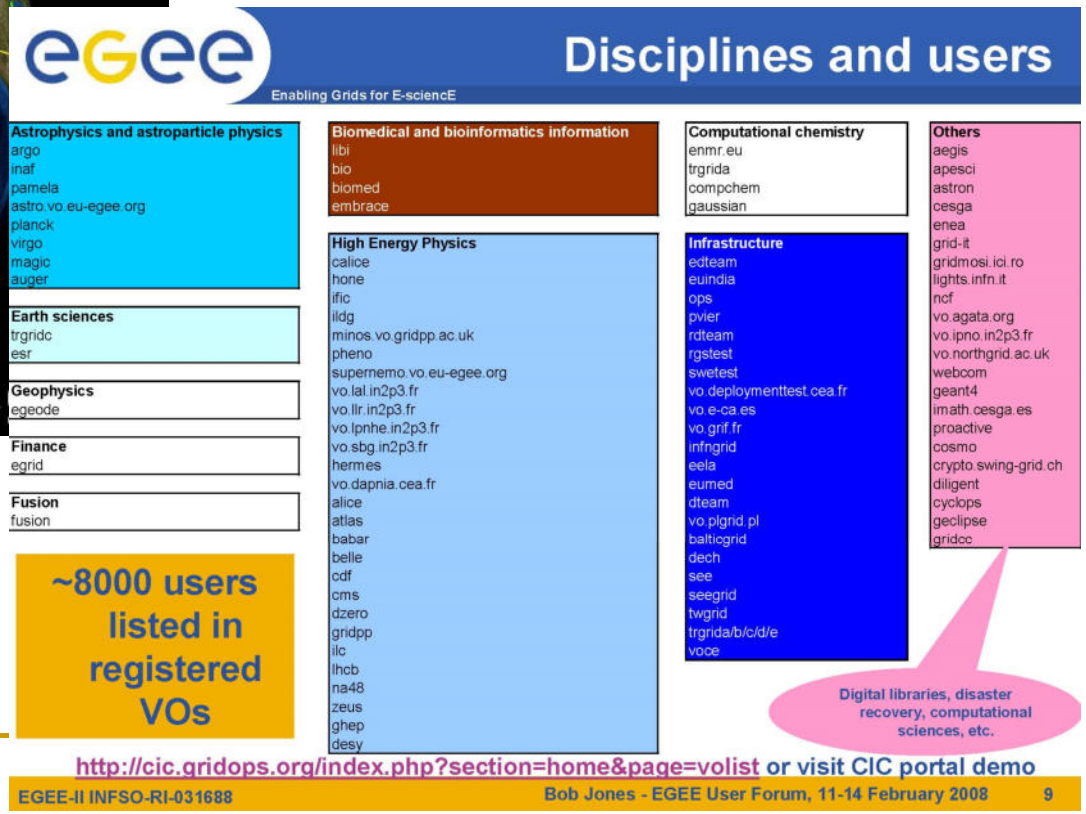
Applications by Topic



From the source...

EGEE – cel mai mare Grid European & LHC





Utilizare EGEE

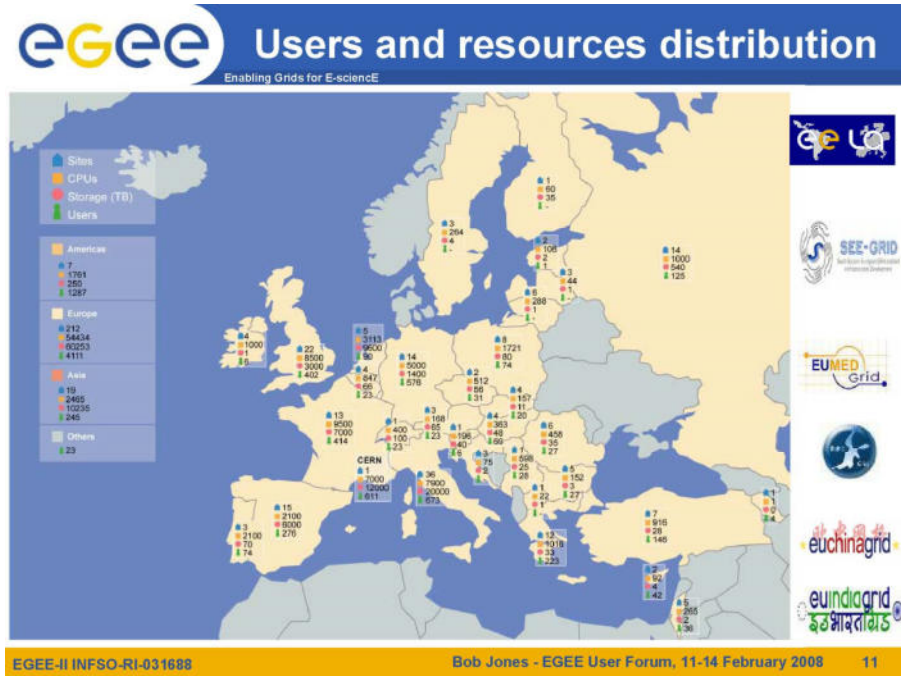
eGee NEWS RELEASE

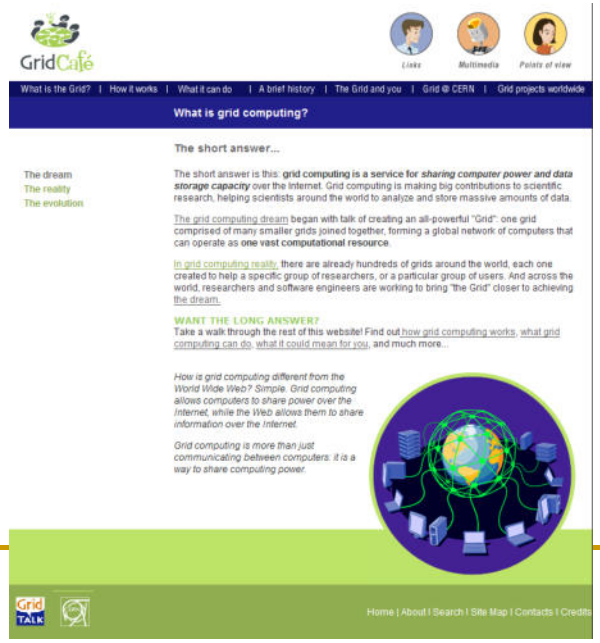
Embargoed until 4 May 2006, 18:00 CCT (10:00 GMT, 12:00 MEST)

EGEE GRID ATTACKS AVIAN FLU

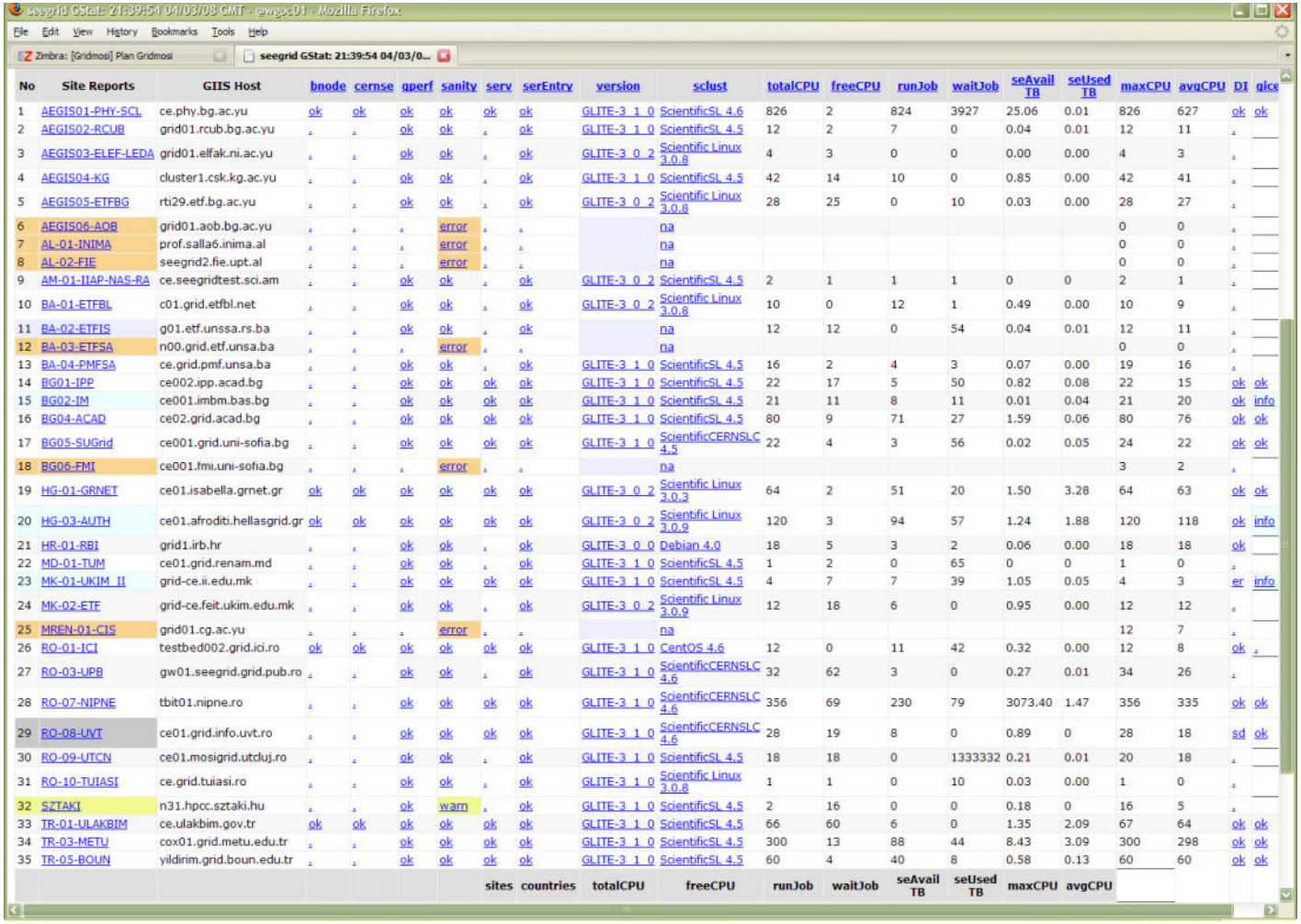
During April, a collaboration of Asian and European laboratories has analysed 300,000 possible drug components against the avian flu virus H5N1 using the EGEE Grid infrastructure. The goal was to find potential compounds that can inhibit the activities of an enzyme on the surface of the influenza virus, the so-called neuraminidase, subtype N1. Using the Grid to identify the most promising leads for biological tests could speed up the development process for drugs against the influenza virus.

One of the targets of existing drugs today on the market is viral neuraminidase, an enzyme that helps the virus to proliferate and infect more cells. As this protein is known to evolve into variants if it comes under drug stress, drug resistance becomes a potential concern in case of an influenza pandemic.





RO in EGEE, SEE-Grid & alte Griduri



seegrid GStat: 21:39:54 04/03/08 GMT - ewgoc01 - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Zimbra: [Gridmosi] Plan Gridmosi | seegrid GStat: 21:39:54 04/03/0...

No	Site Reports	GIIS Host	bnode	cernse	qperf	sanity	serv	serEntry	version	sclust	totalCPU	freeCPU	runJob	waitJob	seAvail TB	seUsed TB	maxCPU	avgCPU	DI	gice
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2	AEGIS02-RCUB	grid01.rcub.bg.ac.yu	.	.	ok	ok	.	ok	GLITE-3_1_0	ScientificSL 4.5	12	2	7	0	0.04	0.01	12	11	.	
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35	TR-05-BOUN	yildirim.grid.boun.edu.tr	.	.	ok	ok	ok	ok	GLITE-3_1_0	ScientificSL 4.5	60	4	40	8	0.58	0.13	60	60	ok	ok
							sites	countries	totalCPU	freeCPU	runJob	waitJob	seAvail TB	seUsed TB	maxCPU	avgCPU				

Traininguri regulate la UVT: SEE-Grid-SCI, EGEE-3 si GiSHEO

Cerinte ale Gridului

- Identitate & autentificare
- Autorizare & politici
- Descoperirea resurselor
- Caracterizarea resurselor
- Alocarea resurselor
- (Co-)rezervarea, workflow
- Algoritmi distribuiti
- Acces la date la distanta
- Transfer de date la viteze mari
- Garantii de performanta
- Adaptarea monitorizarii
- Detectarea intrusilor
- Managementul de resurse
- Conturi & plati
- Managementul esecurilor
- Evolutia sistemului
- Etc.

Cateva cerinte ale Gridului – Perspectiva utilizatorului

- O singura modalitate de alocare
- O singura intrare (sign-on): autentificarea la orice resursa a Gridului duce la autentificarea la toate celelalte
- Un singur spatiu de calcul: un singur planificator pentru toate resursele Grid
- Un singur spatiu de date: poate adresa fisiere si date de la orice resursa a Gridului
- Un singur mediu de dezvoltare: unelte si biblioteci Grid care lucreaza ca toate resursele Grid

Problema securitatii

- Resursele utilizate pot fi extrem de valoroase si problemele alocarii pot fi extrem de sensibile
- Resursele sunt adesea localizate in domenii administrative dinstincte
  – Fiecare resursa poate sa aiba propriile politici si proceduri
  -- Multimea de resurse utilizare la un singur calcul poate fi mare, dinamic si/sau imprevizibil
  – Nu numai client/server
- Pot fi disponibile si aplicabile pe scara larga
  – Standard, bine-testate, protocoale bine intelese
  – Integrarea cu o varietate mare de unelte

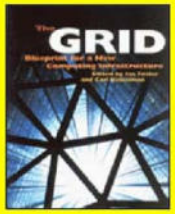
Problema administrarii resurselor

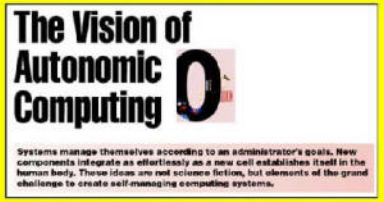
Permiterea accesului securizat, control la distanta a resurselor de calcul si administrarea calculelor de distanta

– Autentificare si autorizare
– Descoperirea si caracterizarea resurselor
– Rezervarea si alocarea
– Monitorizarea si controlul calculului

Conclusions

The idea that each species has been independently created is erroneous





Convergence is a need !